order $(n-2)$, and which the author considers to be also important in reference to the general theory of binary quantities : viz. if $YU = 1I(*\not\subset x, y, z)^n$, $DU = (X\partial_x + Y\partial_y + Z\partial_z)U$, and Y, $\mathbb{D}Y$ are what U, DU become when (x, y, z) and (X, Y, Z) are interchanged ; then the equation is of the form $I . Y + II . \mathbb{D}Y + III . DU + IV . U = 0$. Taking (x, y, z) as current coordinates and $U = 0$ as the equation of the curve, then if (X, Y, Z) are the coordinates of a point on the curve, $Y = 0$, and we have for the equation of the tangent at the point in question $\mathbb{D}Y = 0$. The equation shows that the intersections of the curve $U = 0$ and the tangent $\mathbb{D}Y = 0$, lie on one or other of the curves $III = 0$, $DU = 0$, and that they do not lie on the curve $DU = 0$; consequently they lie on the curve $III = 0$, which is in fact the before-mentioned curve of the order $(n-2)$.

III. "On the Action of Acids on Glycol." By Dr. Maxwell Simpson. Communicated by Dr. Frankland. Received March 24, 1859.

The glycol employed in the following research was prepared according to Dr. Atkinson's excellent method *, to whom is due the credit of having first substituted acetate of potash for acetate of silver in its preparation. He was not the first, however, to prepare it from bromide of ethylene, as M. Wurtz has been in the habit of preparing it from that body for the last two years.

The following slight modification of Dr. Atkinson's method will be found very convenient, particularly when large quantities of glycol are to be prepared. Instead of heating the materials for forming the monoacetate of glycol in a close vessel, they are heated in a large balloon, connected with a Liebig's condenser in such a manner as to cause the condensed vapours to flow back into the balloon.

Action of Sulphuric Acid on Glycol—Sulphoglycolate of Baryta. —Sulphuric acid forms an acid ether with glycol, which gives a soluble salt with baryta. This compound is readily prepared by exposing a mixture of equivalent quantities of glycol and sulphuric acid $(S_2 H_2 O_8)$ to the temperature of $150°$ Cent., diluting with water and neutralizing with carbonate of baryta. This liquid, on being
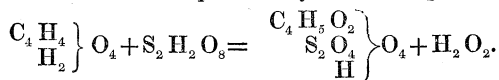
* Philosophical Magazine, Dec. 1858.

filtered, and evaporated on a water-bath to the consistence of a syrup, gives on cooling a white solid mass, which is the body in question. This was pressed between folds of blotting-paper, dried *in vacuo* over sulphuric acid, and analysed. The numbers obtained on analysis lead to the formula

$$\left. \begin{array}{c} C_4 H_5 O_2 \\ S_2 O_4 \\ Ba \end{array} \right\} O_4,$$
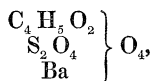
as will be seen from the following per-centage Table :—

	Theory.		I.	II.	III.	IV.
C_4	24·00	11·45	10·71*	——	——	——
H_5	5·00	2·40	2·79	——	——	——
$S_2 O_6$	80·00	38·15	——	38·09	——	——
BaO	76·50	36·51	——	——	36·50	36·10
O_3	24·00	11·49	——	——	——	——
	209·5	109·00				

The formation of this compound may be thus explained :—

$$\left. \begin{array}{c} C_4 H_4 \\ H_2 \end{array} \right\} O_4 + S_2 H_2 O_8 = \left. \begin{array}{c} C_4 H_5 O_2 \\ S_2 O_4 \\ H \end{array} \right\} O_4 + H_2 O_2.$$

On neutralizing this compound with carbonate of baryta, the basic hydrogen is replaced by one atom of barium. I propose to call this salt sulphoglycolate of baryta. It is analogous in composition to the sulphoglycerate of baryta obtained by M. Pelouze. This salt does not readily crystallize. It is almost insoluble in ether and in absolute alcohol, but freely soluble in water. It is somewhat deliquescent. Exposure to the temperature of 100° Cent. causes slight decomposition. From its solution in water, sulphuric acid precipitates sulphate of barytes. Baryta-water occasions no precipitate, at least in the cold; on heating, however, for some time, it becomes turbid, from the separation of the same salt.

Action of Hydrochloric and Acetic Acids on Glycol—Chloracetine of Glycol.—A mixture of equivalent quantities of glycol and glacial acetic acid was introduced into a long tube and saturated with dry hydrochloric acid. The tube was then hermetically sealed, and exposed to the temperature of a water-bath for about four hours. On
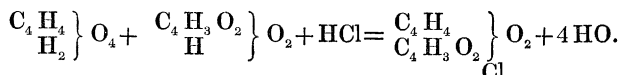
* Chromate of lead was employed in this analysis.

opening the tube and adding water to its contents, a heavy oil separated, which was well washed with the water, in order to remove any acetic acid or undecomposed glycol it might contain, dried over chloride of calcium, and distilled. Almost the entire quantity passed over between 144° and 146°. Specimens obtained at different times gave the following numbers on analysis, which lead to the formula

$$\left.\begin{array}{l} C_4 H_4 \\ C_4 H_3 O_2 \end{array}\right\} O_2.$$
$$Cl$$
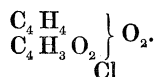
C_8	48·00	39·18	38·96	38·98	——
H_7	7·00	5·71	6·05	5·99	——
O_4	32·00	26·14	——	——	——
Cl	35·50	28·97	——	——	27·48*
	122·50	100·00			

I propose to call this body chloracetine of glycol. It is the intermediate compound between Dutch liquid and diacetate of glycol. Its formation may be thus explained :—

$$\left.\begin{array}{l} C_4 H_4 \\ H_2 \end{array}\right\} O_4 + \left.\begin{array}{l} C_4 H_3 O_2 \\ H \end{array}\right\} O_2 + HCl = \left.\begin{array}{l} C_4 H_4 \\ C_4 H_3 O_2 \end{array}\right\} O_2 + 4 HO.$$
$$Cl$$

Chloracetine of glycol is a colourless liquid, heavier than water, its specific gravity being 1·1783 at 0° Cent. It boils at 145°, distilling without decomposition. It is not decomposed by cold water, at least not to any great extent; even boiling water effects its decomposition with difficulty. Heated with potash, it gives chloride of potassium and acetate of potash. It is probable that the ether of glycol is also formed in this reaction, or perhaps glycol itself. This point I have not yet been able to determine. Chloracetine is isomeric with a compound I obtained a short time ago, by exposing ordinary aldehyde to the action of chloride of acetyle ($C_4 H_3 O_2 Cl$)†. This body differs from the chloracetine in its boiling-point, which is about 23 degrees lower, and in being more readily decomposed both by water and potash. The products formed by the action of potash also establish a difference between these bodies. Both give chloride of potassium and acetate of potash, but the body from aldehyde gives, in addition, resin of aldehyde ; whereas from chloracetine no resin

* A slight loss occurred in this analysis.
† Comptes Rendus, 29 Nov. 1858.

could be obtained. Chloracetine has since been prepared by M. Lorenzo in a manner analogous to that by which I prepared its isomer, namely, by treating glycol with chloride of acetyle. These compounds find their places in two very remarkable series of isomeric bodies, proceeding from ethylene (olefiant gas) and ethylidine ($C_4 H_4$?), supposed to be contained in the chloride of ethylidine derived from aldehyde. The following is a list of these compounds:—

	Ethylidine. $C_4 H_4$ (?)	Ethylene (olefiant gas). $C_4 H_4$	
Aldehyde . .	$C_4 H_4 O_2$	$C_4 H_4 O_2$	Oxide of ethylene. Ether of glycol (Wurtz).
Chloride of ethylidine . (Wurtz)	$C_4 H_4 Cl_2$	$C_4 H_4 Cl_2$	Dutch liquid.
Geuther . .	$\left. \begin{array}{l} C_4 H_4 \\ C_4 H_3 O_2 \\ C_4 H_3 O_2 \end{array} \right\} O_4$	$\left. \begin{array}{l} C_4 H_4 \\ C_4 H_3 O_2 \\ C_4 H_3 O_2 \end{array} \right\} O_4$	Diacetate of glycol (Wurtz).
Chloracetine of ethylidine (Simpson)	$\left. \begin{array}{l} C_4 H_4 \\ C_4 H_3 O_2 \\ Cl \end{array} \right\} O_2$	$\left. \begin{array}{l} C_4 H_4 \\ C_4 H_3 O_2 \\ Cl \end{array} \right\} O_2$	Chlor-acetine of glycol (Simpson).
(Wurtz and Frapolli)	$\left. \begin{array}{l} C_4 H_4 \\ C_4 H_5 \\ Cl \end{array} \right\} O_2$	$\left. \begin{array}{l} C_4 H_4 \\ C_4 H_5 \\ Cl \end{array} \right\} O_2$	Not yet discovered.
Acetal (Döbereiner)	$\left. \begin{array}{l} C_4 H_4 \\ (C_4 H_5)^2 \end{array} \right\} O_4$	$\left. \begin{array}{l} C_4 H_4 \\ (C_4 H_5)^2 \end{array} \right\} O_4$	Diethyl-glycol (Wurtz).

I am still studying the action of acids on glycol, and hope soon to be able to communicate further results. The foregoing experiments were performed in M. Wurtz's laboratory.

The Society then adjourned over the Easter recess to Thursday, May 5.